Dairy Research

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In the future, individual mid-FTIR cow testing may provide real-time farm management data.

Use of FTIR spectra of milk for feeding and health management

Classically, information from the mid-IR spectra was used to measure fat, true protein and anhydrous lactose content of milk. Many secrets are hidden within that mid-FTIR spectral fingerprint and we have only now started to understand how to reveal and make practical use of them. The first secret is the wealth of information about milk fatty acid composition that will be useful for feeding managment of lactating dairy cows. We have just scratched the surface of other predicitive information that can be extracted from the spectra by partial least squares (PLS) statistical modeling and that may allow proactive management of individual cow feeding, health and reproduction. One of the beauties of this approach is that testing is done directly on milk with an instrument and no chemical reagents are needed.

Milk fat contains three groups of fatty acids: those made within the udder (*DeNovo*), those that can be made in the udder or absorbed premade from the blood (mixed origin), and those that cannot be made in the mammary tissue (preformed from the diet or mobilized body fat).

As the proportion of these groups of fatty acids in milk fat changes, it tells us something about how well the rumen fermentation of fiber is functioning and in the transition cow tells us something about how fast the cow is mobilizing body fat. We have developed an IR milk testing method to measure these three groups of fatty acids at a rate of 100 to 600 samples per hour. We are using this newly developed technology for a field study of bulk tank milks from 430 farms in the Northeast US and in research studies on milk from individual cows.

The objectives of our most current work are:

1) measure FA composition of individual producer milks using new chemometric models for FTIR milk analysis; and

2) determine if there are correlations between milk FA composition and bulk tank milk fat and protein tests.

Bulk tank milks from 430 farms were tested three to 20 times per month per farm for 14 months using mid-IR (Lactoscope FTA, Delta Instruments, The Netherlands) for fat, protein and FA composition. Data was organized by breed: Jersey and Holstein. A variety of individual FA and groups of FA were measured. Validation of IR FA results was done by GLC.

The key FA parameter that was positively correlated with bulk tank milk fat and protein concentration was *DeNovo* FA (g/100 g milk). Structural parameters of FA chain length (carbon number) and total unsaturation (double bonds /FA) were negatively correlated with fat and protein (g/100 g milk). This was true for both Jersey and Holstein.

When *DeNovo* FA (relative % of FA) were higher, fat test was higher for both Jersey and Holstein. As *DeNovo* FA (g/100 g milk) increased, fat (g/100 g milk) increased ($P < 0.001$) at a much faster rate (i.e., higher slope) than when preformed FA (g/100 g milk) increased (slope 2.28 vs. 1.29) for Jersey and (slope 2.16 vs. 1.22) for Holstein, for *DeNovo* vs. preformed, respectively. As the proportion of *DeNovo* fatty acids increased (and fat percent increased), the measured FA chain length and double bonds per FA decreased ($P < 0.001$). True protein (g/100 g milk) increased as *DeNovo* FA (g/100 g milk) increased.

We hypothesize that feeding and farm management practices influenced *DeNovo* FA production and milk fat and protein (g/100 g milk) by influencing the volatile fatty acid production in the rumen. A group of 20 Jersey and 20 Holstein farms of interest

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that had a wide range of *DeNovo* FA (g/100 g fat) were selected for a more in-depth field study. This study began in April 2014 to determine if there are cost effective feeding and management practices that can be used to increase fat and protein tests based on monitoring milk FA composition.

During the 14 month period of our study, the 10 Holstein and 10 Jersey low *DeNovo* herds averaged 3.62 and 3.97% fat and 2.99 and 3.15% true protein, while the 10 high *DeNovo* Holstein and Jersey herds averaged 3.92 and 4.80% fat and 3.09 and 3.62% true protein, respectively.

Going forward, this work is leading to individual cow testing directly on large farms by mid-FTIR within the US to provide real-time farm management data. Our vision for the future is the core of the instrument being integrated directly into the milking system. This instrument would collect data on every cow, every milking and transmit data immediately to a central data processing system, with the return message to the farm on individual cows identifed, status and possible managment actions to be taken.

Some measures we have developed that may be useful for individual cow milk testing are blood BHB and blood nonesterfied fatty acids (NEFA) for ketosis prediction. We have also developed models to measure milk trans fatty acids that may be used to predict classical milk fat depression. Our primary focus is to have measures that are predictive to provide advance warning of coming nutritional or health problems before they become severe. Combinations of individual parameters that provide more predictive indices of feed efficicency, rumen pH, ketosis and probability of successful breeding may be derived from the current PLS models for milk analysis.

In the future, our development of PLS models to determine pregnancy status and loss of pregnancy will bring further benefit in the applications of mid-IR milk testing for real-time farm management milk testing. ❒

Using 24 versus 48 hour aerobic culture results for mastitis treatment

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Did this negatively affect the treatment decision? If producers used the 24 hour data, would they have made the wrong choice on that cow? The answer is probably not. If the test stated no growth, or no important growth at 24 hours, and the cow was not systemically ill, she did not receive any treatment. However, if at 48 hours the test showed a gram positive organism that required treatment. This delayed treatment did not affect many cases (39/578 in this study).

Table 1. Categories, description and possible treatment choice

Category	Description	Possible treatment choice
1	No growth, no important growth	No treatment
2	Gram negative	No intramammary treatment, +/- systemic treatment
3	Gram positive	Treatment depends on the pathogen Likely need more information: Streptococcus spp. vs. Staphylococcus spp; Streptococcus identification to species level when possible, and rule out Staphylococcus aureus if Staphylococcus spp.
4	Yeast, Prototheca, mold, etc.	No treatment, +/- cull, dry off quarter

What about *Staphalycoccus aureus*? We don't want to misclassify a cow with a contagious pathogen at 24 hours and have it change at 48 hours! In this study, at the QMPS lab, there were no such instances. Zero cases were labeled as *Staphalycoccus aureus* at 24 hours and then changed at 48 hours. However, most cases (56/85) were identified as *Staphalycoccus aureus* at 48 hours.

What about gram negative organisms? Of the 462 gram negative organisms identified, most (438) were identified as gram negative within 24 hours and when possible more information was provided (e.g., *Klebsiella*) at 48 hours.

What about category 4, "other"? Category 4 includes: yeast, mold, *Nocardia*, *Prototheca*, and fungus. There were very few cases. On day one there were 28 out 1,779 cultures, however, one changed from category 4 on day one to category 2 on day two.

What does this mean to the average producer? If you work with a certified lab, the results of this study should be comparable. However it never hurts to ask. A certified lab should undergo proficiency testing and quality assurance on a regular basis. If you evaluate milk cultures on your own farm, it is easy to compare the results at 24 hours versus 48 hours and evaluate whether your treatment decision would change. However, you first have to know if you're doing the right thing. Please consider proficiency testing and quality assurance for your lab on a regular basis. The ability to use the information at 24 hours to make prudent antibiotic treatment decisions with accurate information can save you time and money. ❒